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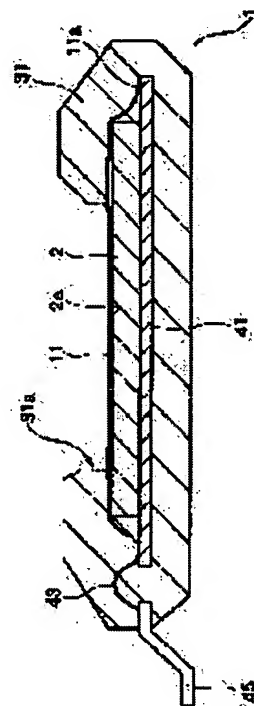
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(54) CAPACITANCE TYPE FINGERPRINT SENSOR

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a capacitance type fingerprint sensor capable of preventing electrostatic breakdown due to discharge, for example, of capacitance detection cells constituting the capacitance type fingerprint sensor from a finger, and a manufacturing method therefor.

SOLUTION: This capacitance type fingerprint sensor 1 has a plurality of capacitance detection cells detecting electrically the capacitance changed in accordance with the distances to the fingerprint, and recognizes the fingerprint based on the results of detection of each capacitance detection cell. In this case, a wire 11 as a conductive wire material giving reference potential for the fingerprint is stretched and provided by crossing a detection face 2a on which the capacitance detection cells are provided.



LEGAL STATUS

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CLAIMS

[Claim(s)]

[Claim 1] The electrostatic-capacity type fingerprint sensor which is the electrostatic-capacity type fingerprint sensor which has two or more cels for electrostatic-capacity detection which detect electrically the electrostatic capacity which changes according to the distance between fingerprints, and recognizes said fingerprint based on the detection result of each of said cel for electrostatic detection and by which the conductive wire rod which gives a reference potential to said fingerprint is ****(ed) by crossing the detection side in which two or more of said cels for electrostatic-capacity detection were prepared.

[Claim 2] Said wire rod is an electrostatic-capacity type fingerprint sensor according to claim 1 in contact with said detection side.

[Claim 3] Said wire rod is an electrostatic-capacity type fingerprint sensor according to claim 1 currently isolated from said detection side.

[Claim 4] It is the electrostatic-capacity type fingerprint sensor according to claim 1 by which it has the semiconductor chip with which said two or more cels for electrostatic-capacity detection were formed, the attachment component which has the conductivity holding said semiconductor chip, and the package member which covers said semiconductor chip and attachment component where the detection side of said semiconductor chip is exposed, and is fixed, and the both ends of said wire rod are being fixed by said package member to said semiconductor chip.

[Claim 5] Said package member is an electrostatic-capacity type fingerprint sensor according to claim 3 which consists of a resin ingredient.

[Claim 6] Said wire rod is an electrostatic-capacity type fingerprint sensor according to claim 4 electrically connected with said attachment component through the inside of said package member.

[Claim 7] It is the electrostatic-capacity type fingerprint sensor according to claim 6 by which it has the electrode for reference potentials which was prepared so that a part might project from the package member concerned in said package member, and which is connected to a reference potential, and said electrode for reference potentials is connected with said attachment component by the conductive ingredient.

[Claim 8] It is the electrostatic-capacity type fingerprint sensor according to claim 4 by which the spacing member for holding in the location which isolates said wire rod in a predetermined distance from the detection side concerned is prepared in the detection side side of said semiconductor chip, and said wire rod is being fixed by said package member on said spacing member.

[Claim 9] Said spacing member is an electrostatic-capacity type fingerprint sensor according to claim 7 which consists of the same ingredient as said package member.

[Claim 10] Said wire rod is an electrostatic-capacity type fingerprint sensor according to claim 1 which consists of a carbon fiber.

[Claim 11] Said cel for electrostatic-capacity detection is an electrostatic-capacity type fingerprint sensor according to claim 1 which has an electrode for detection, and the insulating protective coat of the predetermined thickness which covers said electrode for detection.

[Claim 12] It is the electrostatic-capacity type fingerprint sensor according to claim 1 by which it has further the digital disposal circuit which processes the detecting signal of said cel for electrostatic-capacity detection, and specifies said fingerprint, and said wire rod crosses said digital disposal circuit, or said wire rod processes specifically the detecting signal of the cel for electrostatic-capacity detection which passes through near.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the electrostatic-capacity type fingerprint sensor and its manufacture approach for specifying a fingerprint.

[0002]

[Description of the Prior Art] for example, the fingerprint authentication system used for close leaving management etc. -- him, such as a security system on a computer network, a personal digital assistant, and an IC card, -- it is beginning to be applied also as an authentication tool. In the above-mentioned fingerprint authentication system, the electrostatic-capacity type fingerprint sensor is developed as a fingerprint sensor for recognizing a fingerprint. An electrostatic-capacity type fingerprint sensor detects electrically the electrostatic capacity which gives a reference potential to a finger and is formed between this reference potential and the electrode in a fingerprint sensor. According to the irregularity of a fingerprint, the distance of a reference potential and an electrode changes and electrostatic capacity changes. The crest of a fingerprint is specified by taking out electrically change of the electrostatic capacity corresponding to the irregularity of this fingerprint.

[0003]

[Problem(s) to be Solved by the Invention] Here, drawing 10 is the top view showing an example of the structure of the above-mentioned electrostatic-capacity type fingerprint sensor, and drawing 11 is the sectional view showing an example of the structure of the above-mentioned electrostatic-capacity type fingerprint sensor. As shown in drawing 10, the electrostatic-capacity type fingerprint sensor 101 has two or more electrodes 102 for electrostatic-capacity detection arranged in the shape of a matrix, and the electrostatic-capacity detector cell is constituted by each electrode 102 for electrostatic-capacity detection. Moreover, on the electrode 102 for electrostatic-capacity detection, as shown in drawing 11, the insulating protective coat 103 is covered. By the electrostatic-capacity type fingerprint sensor 101 of the above-mentioned structure, in order to make a finger into a reference potential recognizing a fingerprint, for example, as shown in drawing 12, the reference potential electrode 105 was arranged near the detection side 101a of the electrostatic-capacity type fingerprint sensor 101, and the reference potential is given to Finger F. However, before the body tended to be electrified and the reference potential electrode 105 gave the reference potential to Finger F, discharge may occur between Finger F and the electrostatic-capacity type fingerprint sensor 101, and dielectric breakdown of the protective coat 103 grade of the electrostatic-capacity detector cell of the electrostatic-capacity type fingerprint sensor 101 might be carried out by this.

[0004] This invention is made in view of the problem mentioned above, and aims at offering the electrostatic-capacity type fingerprint sensor which can control the electrostatic discharge by the discharge from a finger etc. of the cel for electrostatic-capacity detection which constitutes an electrostatic-capacity type fingerprint sensor.

[0005]

[Means for Solving the Problem] This invention has two or more cels for electrostatic-capacity detection

which detect electrically the electrostatic capacity which changes according to the distance between fingerprints, and it is an electrostatic-capacity type fingerprint sensor which recognizes said fingerprint based on the detection result of each of said cel for electrostatic detection, and the conductive wire rod which gives a reference potential to said fingerprint crosses the detection side in which said two or more cels for electrostatic-capacity detection were prepared, and it is ****(ed).

[0006] Said wire rod touches said detection side.

[0007] Said wire rod is being isolated from said detection side.

[0008] It has the semiconductor chip with which said two or more cels for electrostatic-capacity detection were formed, the attachment component which has the conductivity holding said semiconductor chip, and the package member which covers said semiconductor chip and attachment component where the detection side of said semiconductor chip is exposed, and is fixed, and the both ends of said wire rod are being fixed by said package member to said semiconductor chip.

[0009] Said package member consists of a resin ingredient.

[0010] Said wire rod is electrically connected with said attachment component through the inside of said package member.

[0011] It has the electrode for reference potentials which was prepared so that a part might project from the package member concerned in said package member and which is connected to a reference potential, and said electrode for reference potentials is connected with said attachment component by the conductive ingredient.

[0012] The spacing member for holding in the location which isolates said wire rod in a predetermined distance from the detection side concerned is prepared in the detection side side of said chip, and said wire rod is being fixed by said package member on said spacing member.

[0013] Said spacing member consists of the same ingredient as said package member.

[0014] Said wire rod consists of a carbon fiber.

[0015] Said cel for electrostatic-capacity detection has an electrode for detection, and the insulating protective coat of the predetermined thickness which covers said electrode for detection.

[0016] It has further the digital disposal circuit which processes the detecting signal of said cel for electrostatic-capacity detection, and specifies said fingerprint, and said wire rod crosses said digital disposal circuit, or said wire rod processes specifically the detecting signal of the cel for electrostatic-capacity detection which passes through near.

[0017] In this invention, the wire rod which has the conductivity which gives a reference potential to a fingerprint so that it may cross to the control surface which detects a fingerprint is ****(ed). If a finger is pressed against a control surface, in order that a finger may contact a wire rod certainly, even if the discharge from a finger occurs, static electricity will escape through a wire rod. For this reason, it is controlled that the cel for electrostatic-capacity detection is destroyed by discharge.

[0018]

[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained with reference to a drawing.

1st operation gestalt drawing 1 is the sectional view showing the structure of 1 operation gestalt of the electrostatic-capacity type fingerprint sensor of this invention, drawing 2 is the sectional view showing the structure of the cel for electrostatic-capacity detection, and drawing 3 is the top view showing the structure by the side of the detection side of a semiconductor chip. As shown in drawing 1 - drawing 3, the electrostatic-capacity type fingerprint sensor 1 concerning this operation gestalt has a semiconductor chip 2, a die pad 41, the package member 31, a wire 11, and an earth electrode 45.

[0019] Two or more cels 3 for electrostatic-capacity detection for a semiconductor chip 2 to detect a fingerprint, as shown in drawing 3 are formed in the shape of a matrix. A semiconductor chip 2 is 2 several cm, for example. It has the area of extent, and the cel 2 for electrostatic-capacity detection is formed by the order of tens of thousands - 100,000 numbers in this area, for example, it is arranged at intervals of several micrometers - dozens of micrometers. As shown in drawing 3, the cel 3 for electrostatic-capacity detection has the electrode 21 which consists of a conductive ingredient formed on the insulating layer 20, and these electrodes 21 are covered with the protective coat 22 which consists of

a dielectric. In addition, the maximum front face of a protective coat 22 is the above-mentioned detection side 2a. The electrode 21 of the cel 3 for electrostatic-capacity detection is formed from metallic materials, such as aluminum, and die length of one side is formed in dozens of micrometers. A protective coat 22 is SiN and SiO₂. It is the film with a thickness of several micrometers used as a base material.

[0020] the formation approach of the cel 3 for electrostatic-capacity detection -- for example, a semiconductor substrates top, such as a silicon substrate, -- at least -- an insulating layer -- minding -- for example, CVD (Chemical Vapour Deposition) -- the conductive layer which consists of a metallic material using law etc. is formed, patterning is carried out using the usual photolithography technique, an electrode 21 is formed, and a protective coat 22 is made to deposit in predetermined thickness so that an electrode 21 may be covered

[0021] The die pad 41 holds the semiconductor chip 2 through a binder. A die pad 41 is a plate which consists of a metallic material which has conductivity, such as copper and aluminum.

[0022] The package member 31 is formed so that a semiconductor chip 2 and a die pad 4 may be covered, and it is fixing the semiconductor chip 2 and the die pad 4. Moreover, the package member 31 is formed from the resin ingredient used for the package of the usual semiconductor device. Moreover, the package member 31 has opening 3a so that detection side 2a of a semiconductor chip 2 may be exposed.

[0023] Although a wire 11 is a wire rod which has conductivity, for example, wire rods, such as a stainless steel wire, can be used for it, with this operation gestalt, a carbon fiber is used for it from a viewpoint on reinforcement. As a wire 11 crosses detection side 2a, and is ****(ed), where detection side 2a of a semiconductor chip 2 is contacted, for example, shown in drawing 3, it is prepared so that the cel 3 for electrostatic-capacity detection arranged in the same direction as shown by hatching may be crossed. Moreover, for example, as shown in drawing 4, you may prepare so that between each cel 3 for electrostatic-capacity detection arranged in the same direction may be crossed. The both ends of a wire 11 are being fixed in one in the package member 31 to the semiconductor chip 2, as shown in drawing 1.

[0024] It connected with the front face of a die pad 41, and the wire 11 and the die pad 41 have flowed through end section 11a of a wire 11 electrically.

[0025] It is fixed in the package member 31, and the earth electrode 45 is formed so that a part may project from the package member 31. The earth electrode 45 is electrically connected with the die pad 41 by the conductive members 43, such as a gold streak and an aluminum wire. The conductive member 43 exists in the package member 31.

[0026] Drawing 5 is the mimetic diagram showing the electric configuration of the electrostatic-capacity type fingerprint sensor 1 concerning this operation gestalt. As shown in drawing 5, the electrode 21 of each cel 3 for electrostatic-capacity detection is connected to the digital disposal circuit 51 through the transistor 40 which functions as a switch. The gate of the transistor 40 connected to the cel 3 for electrostatic-capacity detection located in a line with the same line among the cels 3 for electrostatic-capacity detection arranged in the shape of a matrix is connected to the selection line WL. A digital disposal circuit 51 is a circuit which specifies the image of the fingerprint of Finger F based on the detecting signal which each cel 3 for electrostatic-capacity detection detected.

[0027] Here, the detection principle of the fingerprint of the electrostatic-capacity type fingerprint sensor 1 is explained. As shown in drawing 6, the electrode 21 of each cel 4 for electrostatic-capacity detection is connected to the selection line BL of the direction of a train through a transistor 40, and the gate of a transistor 40 is connected to the selection line WL of a line writing direction. When the finger F which gave the reference potential is located in the location of distance d from an electrode 21, the electrostatic capacity Cs between an electrode 21 and Finger F is expressed by the degree type (1). In addition, epsilon 0 It is the dielectric constant of air, epsilon is the dielectric constant of the protective coat 22 on an electrode 21, and S is the area of an electrode 21.

[0028] $C_s = \epsilon \cdot \epsilon_0 \cdot S / d$ -- (1)

[0029] Therefore, in the condition of not making Finger F countering the electrode 21 of the

electrostatic-capacity type fingerprint sensor 1, the distance d of an electrode 21 and Finger F becomes infinite, and the electrostatic capacity C_s on an electrode 21 is set to 0.

[0030] When the electrode 21 of the electrostatic-capacity type fingerprint sensor 1 is made to approach where a reference potential E is given to Finger F as shown in drawing 7, the distance d of Electrodes 21a and 21b and Finger F changes like d_1 and d_2 with irregularity of the fingerprint which Finger F has, respectively. If the selection line BL is precharged on the predetermined electrical potential difference V_{cc} , an electrical potential difference is impressed to the selection line WL at this time and a transistor 40 is turned on, the charge according to the electrostatic capacity C_s determined with distance d_1 and d_2 will be accumulated in each electrodes 21a and 21b, and the potential of the selection line BL will change according to the amount of these charges. Potential variation ΔV of the selection line BL is expressed with a degree type (2) when parasitic capacitance of the selection line BL is set to C_b .

[0031]

$$\Delta V = \{C_s / (C_b + C_s)\} V_{cc} \quad (2)$$

[0032] Potential variation ΔV is an amount according to the electrostatic capacity C_s determined with the distance d of an electrode 21 and Finger F, and can specify the concave convex voice of the fingerprint which Finger F has by reading to the digital disposal circuit 51 which described above potential variation ΔV of the selection line BL in each cel 2 for electrostatic-capacity detection.

[0033] Next, an example of fingerprint detection actuation of the electrostatic-capacity type fingerprint sensor 1 of the above-mentioned configuration is explained. For example, the finger F contacted in the electrostatic-capacity type fingerprint sensor 1 is charged, and before giving a reference potential E to Finger F, the case where it discharges towards the electrostatic-capacity type fingerprint sensor 1 from Finger F is considered. In addition, the earth electrode 45 of the electrostatic-capacity type fingerprint sensor 1 shall be grounded. Since the wire 11 will cross on detection side 2a if Finger F is contacted to detection side 2a of a semiconductor chip 2 as shown in drawing 8, Finger F is contact ***** certainly on a wire 11. The touch-down potential which is a reference potential is given to Finger F by this. If the body is charged and it discharges from Finger F when Finger F is brought close to detection side 2a of a semiconductor chip 2, the discharge current will flow on a wire 11 and will be led to the earth electrode 45 grounded through the die pad 41 and the conductive member 43. For this reason, it is controlled that the protective coat 22 grade which the discharge current does not flow directly in the cel 3 for electrostatic-capacity detection, and the cel 3 for electrostatic-capacity detection has by discharge carries out dielectric breakdown. As mentioned above, according to this operation gestalt, the cel 3 for electrostatic-capacity detection becomes that it is hard to be destroyed even if discharge arises from Finger F by having formed the wire 11 which has conductivity on detection side 2a in which two or more cels 3 for electrostatic-capacity detection were formed.

[0034] Here, in order that Finger F may contact a wire 11 where Finger F is contacted to detection side 2a of a semiconductor chip 2 as shown in drawing 8, Finger F deforms in this surface of action. For this reason, the insensible field R which cannot detect a fingerprint occurs in the field which deformed Finger F. For example, when it prepares so that the cel 3 for electrostatic-capacity detection which arranges a wire 11 in the same direction may be crossed as shown in drawing 3, each cel 3 for electrostatic-capacity detection on a par with the single tier shown by hatching in drawing 3 will be located in an insensible field R. Moreover, as shown in drawing 4, when a wire 11 is formed between the cels 3 for electrostatic-capacity detection arranged in the same direction, each cel 3 for electrostatic-capacity detection of two adjacent trains shown by hatching in drawing 4 will be located in an insensible field R.

[0035] The cel 3 for electrostatic-capacity detection located in an insensible field R is beforehand specified according to arrangement of a wire 11 in the assembly phase of the electrostatic-capacity type fingerprint sensor 1. For this reason, with this operation gestalt, the detecting signal of the cel 3 for electrostatic-capacity detection located in an insensible field R by the digital disposal circuit 51 is processed specifically, for example. Specifically, a digital disposal circuit 51 can be considered as the configuration which does not use the detecting signal of the cel 3 for electrostatic-capacity detection located in an insensible field R for specification of a fingerprint. In this case, the overview of a

fingerprint can be specified by making a different location to detection side 2a of a semiconductor chip 2 carry out multiple-times contact of the finger F, and compounding the data obtained by detection of multiple times. Or the algorithm which processes specially the detecting signal of the cel 3 for electrostatic-capacity detection located in an insensible field R is prepared beforehand, and it is also possible to specify the overview of a fingerprint by complementing the detecting signal of the cel 3 for electrostatic-capacity detection located in an insensible field R with this algorithm.

[0036] 2nd operation gestalt drawing 9 is the sectional view showing the structure of 1 operation gestalt of the electrostatic-capacity type fingerprint sensor of this invention. In addition, the same sign shows the same component as the 1st operation gestalt mentioned above among the components of the electrostatic-capacity type fingerprint sensor 201 shown in drawing 9. A different point of the electrostatic-capacity type fingerprint sensor 201 concerning this operation gestalt and the electrostatic-capacity type fingerprint sensor 1 concerning the 1st operation gestalt is a point which the wire 11 is isolating in detection side 2a of a semiconductor chip 2, and the predetermined distance delta by the electrostatic-capacity type fingerprint sensor 201.

[0037] That is, by the electrostatic-capacity type fingerprint sensor 201, two or more spacing members 46 of height delta are formed on the semiconductor chip 2, and a wire 11 is ****(ed) on a spacing member 46, and is being fixed to the package member 31 and one. A spacing member 46 can be formed with the same resin ingredient as the package member 31.

[0038] With this operation gestalt, if Finger F is brought close to detection side 2a of a semiconductor chip 2 by considering as such a configuration, since it is near, even if the wire 11 discharges from Finger F with Finger F rather than detection side 2a of a semiconductor chip 2, the discharge current is certainly led to a wire 11, and can prevent certainly the electrostatic discharge of the cel for electrostatic-capacity detection formed in the semiconductor chip 2.

[0039]

[Effect of the Invention] According to this invention, even if there is discharge from a finger by having prepared the wire which gives a reference potential, the electrostatic discharge of the cel for electrostatic-capacity detection can be certainly prevented, so that the detection side of an electrostatic-capacity type fingerprint sensor may be crossed, and a reference potential can be given to a finger.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the sectional view showing the configuration of 1 operation gestalt of the electrostatic-capacity type fingerprint sensor concerning this invention.

[Drawing 2] It is the sectional view showing the structure of the cel for electrostatic-capacity detection.

[Drawing 3] It is the top view showing the structure by the side of the detection side of a semiconductor chip.

[Drawing 4] It is the top view showing other examples of structure by the side of the detection side of a semiconductor chip.

[Drawing 5] It is the mimetic diagram showing the electric configuration of the electrostatic-capacity type fingerprint sensor 1.

[Drawing 6] It is the top view showing an example of the structure of an electrostatic-capacity type fingerprint sensor.

[Drawing 7] It is drawing for explaining the detection principle of an electrostatic-capacity type fingerprint sensor.

[Drawing 8] It is drawing showing the condition of having made Finger F approaching detection side 2a of the semiconductor chip 2 of the electrostatic-capacity type fingerprint sensor 1. It is the sectional view showing an example of the structure of an electrostatic-capacity type fingerprint sensor.

[Drawing 9] It is the sectional view showing the configuration of other operation gestalten of the electrostatic-capacity type fingerprint sensor concerning this invention.

[Drawing 10] It is the top view showing an example of the structure of an electrostatic-capacity type fingerprint sensor.

[Drawing 11] It is the sectional view showing an example of the structure of the electrostatic-capacity type fingerprint sensor of drawing 10 .

[Drawing 12] In case a finger is contacted in an electrostatic-capacity type fingerprint sensor, it is drawing showing signs that a reference potential is given to a finger.

[Description of Notations]

1 [-- The cel for electrostatic-capacity detection, 11 / -- A wire, 31 / -- A package member, 43 / -- A conductive member, 45 / -- An earth electrode, 21 / -- An electrode, 22 / -- A protective coat, 41 / -- Die pad.] -- An electrostatic-capacity type fingerprint sensor, 2 -- A semiconductor chip, 2a -- A detection side, 3

[Translation done.]

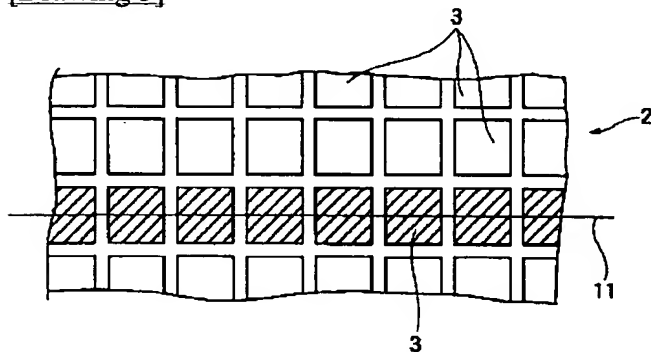
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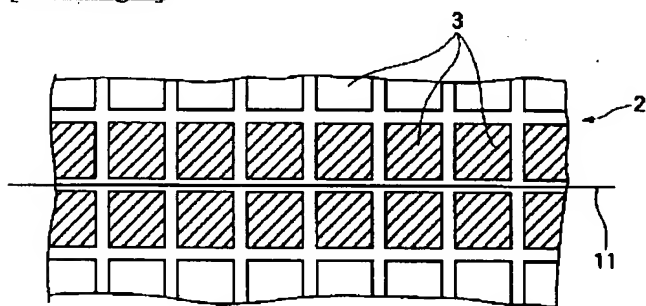
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DRAWINGS

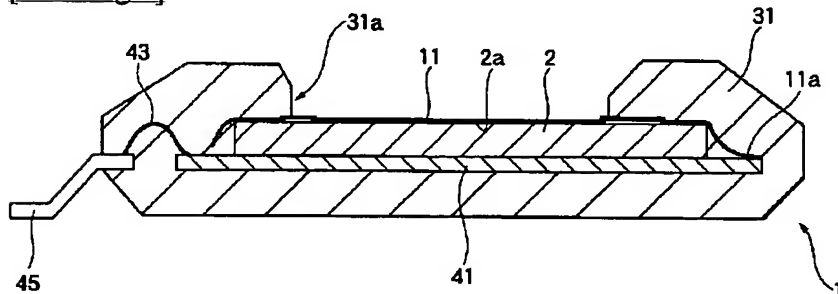
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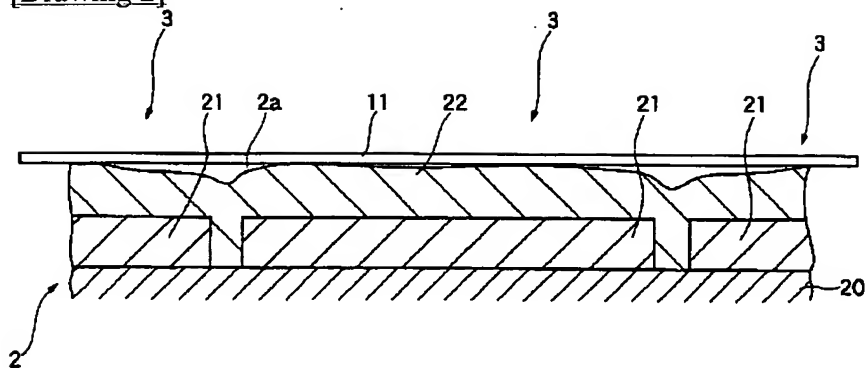
[Drawing 4]



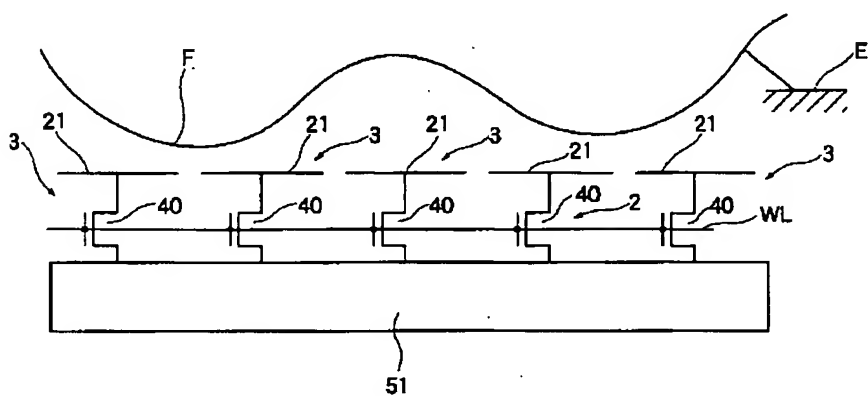
[Drawing 1]



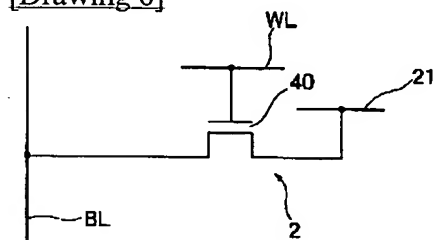
[Drawing 2]



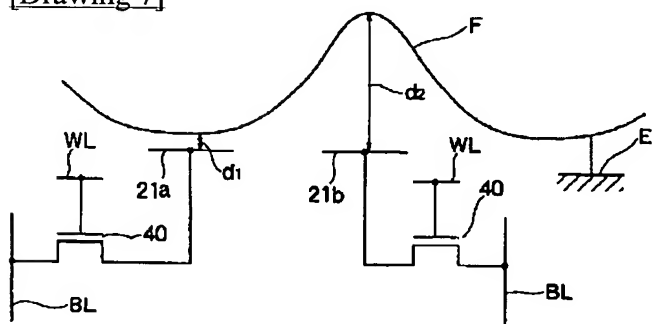
[Drawing 5]



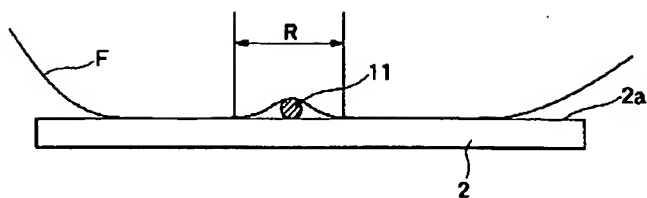
[Drawing 6]



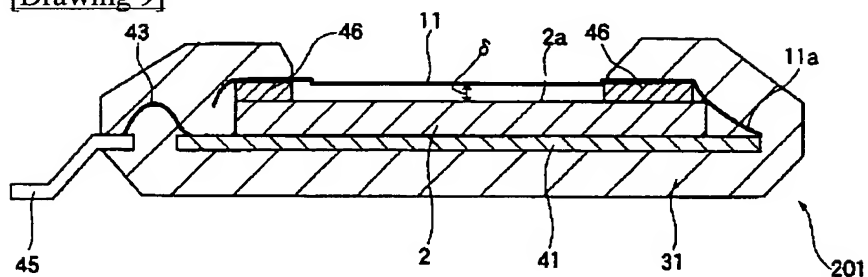
[Drawing 7]



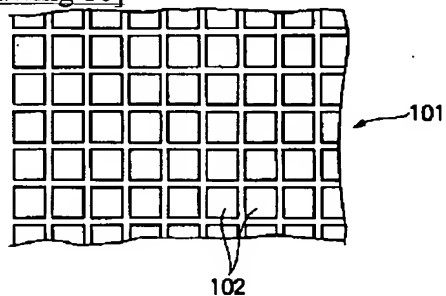
[Drawing 8]



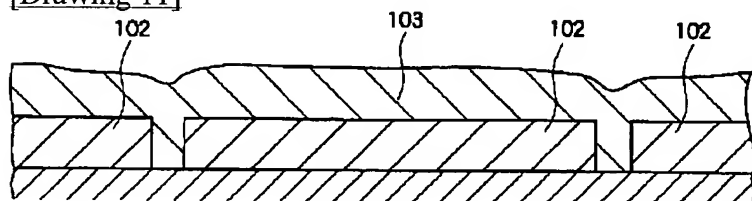
[Drawing 9]



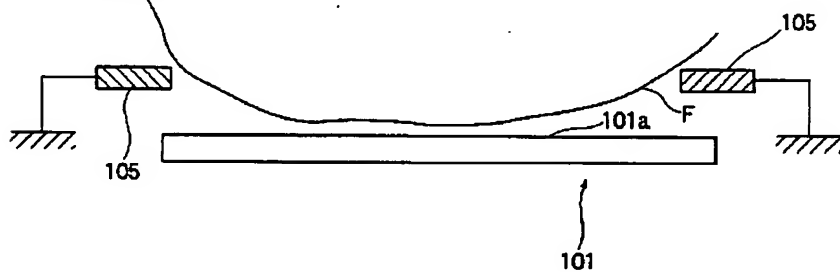
[Drawing 10]



[Drawing 11]



[Drawing 12]



[Translation done.]

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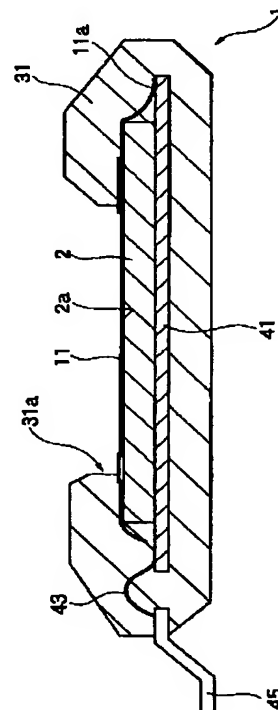
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(54) 【発明の名称】 静電容量式指紋センサ

(57) 【要約】

【課題】 静電容量式指紋センサを構成する静電容量検出用セルの、たとえば、指等からの放電による静電破壊を抑制可能な静電容量式指紋センサおよびその製造方法を提供する。

【解決手段】 指紋との間の距離に応じて変化する静電容量を電気的に検出する複数の静電容量検出用セルを有し、各静電検出用セル3の検出結果に基づいて指紋を認識する静電容量式指紋センサ1であって、指紋に対して基準電位を与える導電性の線材としてのワイヤ11が静電容量検出用セル3が設けられた検出面2aを横切って架張されている。



(2)

【特許請求の範囲】

【請求項1】 指紋との間の距離に応じて変化する静電容量を電気的に検出する複数の静電容量検出用セルを有し、前記各静電検出用セルの検出結果に基づいて前記指紋を認識する静電容量式指紋センサであって、前記指紋に対して基準電位を与える導電性の線材が前記複数の静電容量検出用セルが設けられた検出面を横切って架張されている静電容量式指紋センサ。

【請求項2】 前記線材は、前記検出面に接触している請求項1に記載の静電容量式指紋センサ。

【請求項3】 前記線材は、前記検出面から離隔している請求項1に記載の静電容量式指紋センサ。

【請求項4】 前記複数の静電容量検出用セルが形成された半導体チップと、前記半導体チップを保持する導電性を有する保持部材と、前記半導体チップの検出面を露出させた状態で前記半導体チップと保持部材とを被覆しかつ固定するパッケージ部材と、を有し、前記線材の両端部は、前記パッケージ部材によって前記半導体チップに対して固定されている請求項1に記載の静電容量式指紋センサ。

【請求項5】 前記パッケージ部材は、樹脂材料からなる請求項3に記載の静電容量式指紋センサ。

【請求項6】 前記線材は、前記パッケージ部材内を通過して前記保持部材と電気的に接続されている請求項4に記載の静電容量式指紋センサ。

【請求項7】 前記パッケージ部材に一部が当該パッケージ部材から突出するように設けられた、基準電位に接続される基準電位用電極を有し、前記基準電位用電極は、導電性材料によって前記保持部材と接続されている請求項6に記載の静電容量式指紋センサ。

【請求項8】 前記半導体チップの検出面側には、前記線材を当該検出面から所定の距離で離隔する位置に保持するためのスペーサ部材が設けられており、前記線材は、前記スペーサ部材上に前記パッケージ部材によって固定されている請求項4に記載の静電容量式指紋センサ。

【請求項9】 前記スペーサ部材は、前記パッケージ部材と同じ材料からなる請求項7に記載の静電容量式指紋センサ。

【請求項10】 前記線材は、カーボンファイバからなる請求項1に記載の静電容量式指紋センサ。

【請求項11】 前記静電容量検出用セルは、検出用電極と、前記検出用電極を被覆する所定膜厚の絶縁性の保護膜とを有する請求項1に記載の静電容量式指紋センサ。

【請求項12】 前記静電容量検出用セルの検出信号を処理して前記指紋を特定する信号処理回路をさらに有し、前記信号処理回路は、前記線材が横切る、あるいは、前

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記線材が近傍を通過する静電容量検出用セルの検出信号を特定の処理する請求項1に記載の静電容量式指紋センサ。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】 本発明は、指紋を特定するための静電容量式指紋センサおよびその製造方法に関する。

【0002】

10 【従来の技術】 たとえば、入退室管理等に用いられていた指紋照合システムは、コンピュータネットワーク上のセキュリティシステム、携帯端末、ICカード等の本人認証ツールとしても応用されはじめている。上記の指紋照合システムでは、指紋を認識するための指紋センサとして、静電容量式指紋センサが開発されている。静電容量式指紋センサは、指に基準電位を与えてこの基準電位と指紋センサ内の電極との間に形成される静電容量を電気的に検出する。指紋の凹凸に応じて、基準電位と電極との距離が変化し、静電容量が変化する。この指紋の凹凸に対応した静電容量の変化を電気的に取り出すことにより、指紋の紋様を特定する。

【0003】

【発明が解決しようとする課題】 ここで、図10は上記の静電容量式指紋センサの構造の一例を示す平面図であり、図11は上記の静電容量式指紋センサの構造の一例を示す断面図である。図10に示すように、静電容量式指紋センサ101は、マトリクス状に配置された複数の静電容量検出用電極102を有しており、各静電容量検出用電極102について静電容量検出セルが構成されて
30 いる。また、静電容量検出用電極102上には、図11に示すように、絶縁性の保護膜103が被覆されている。上記構造の静電容量式指紋センサ101では、指紋を認識するのに指を基準電位とするため、たとえば、図12に示すように、静電容量式指紋センサ101の検出面101aの近傍に基準電位電極105を配設して指Fに基準電位を付与している。しかしながら、人体は静電気を帯びやすく、指Fに基準電位電極105によって基準電位を付与する前に、指Fと静電容量式指紋センサ101との間で放電が発生することがあり、これによっ
40 て、静電容量式指紋センサ101の静電容量検出セルの保護膜103等が絶縁破壊されることがあった。

【0004】 本発明は、上述した問題に鑑みてなされたものであって、静電容量式指紋センサを構成する静電容量検出用セルの、たとえば、指等からの放電による静電破壊を抑制可能な静電容量式指紋センサを提供することを目的とする。

【0005】

【課題を解決するための手段】 本発明は、指紋との間の距離に応じて変化する静電容量を電気的に検出する複数の静電容量検出用セルを有し、前記各静電検出用セルの

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検出結果に基づいて前記指紋を認識する静電容量式指紋センサであって、前記指紋に対して基準電位を与える導電性の線材が前記複数の静電容量検出用セルが設けられた検出面を横切って架張されている。

【0006】前記線材は、前記検出面に接触している。

【0007】前記線材は、前記検出面から離隔している。

【0008】前記複数の静電容量検出用セルが形成された半導体チップと、前記半導体チップを保持する導電性を有する保持部材と、前記半導体チップの検出面を露出させた状態で前記半導体チップと保持部材とを被覆しかつ固定するパッケージ部材と、を有し、前記線材の両端部は、前記パッケージ部材によって前記半導体チップに対して固定されている。

【0009】前記パッケージ部材は、樹脂材料からなる。

【0010】前記線材は、前記パッケージ部材内を通過して前記保持部材と電気的に接続されている。

【0011】前記パッケージ部材に一部が当該パッケージ部材から突出するように設けられた、基準電位に接続される基準電位用電極を有し、前記基準電位用電極は、導電性材料によって前記保持部材と接続されている。

【0012】前記チップの検出面側には、前記線材を当該検出面から所定の距離で離隔する位置に保持するためのスペーサ部材が設けられており、前記線材は、前記スペーサ部材上に前記パッケージ部材によって固定されている。

【0013】前記スペーサ部材は、前記パッケージ部材と同じ材料からなる。

【0014】前記線材は、カーボンファイバからなる。

【0015】前記静電容量検出用セルは、検出用電極と、前記検出用電極を被覆する所定膜厚の絶縁性の保護膜とを有する。

【0016】前記静電容量検出用セルの検出信号を処理して前記指紋を特定する信号処理回路をさらに有し、前記信号処理回路は、前記線材が横切る、あるいは、前記線材が近傍を通過する静電容量検出用セルの検出信号を特定の処理する。

【0017】本発明では、指紋を検出する検査面に横切るように指紋に基準電位を与える導電性を有する線材が架張されている。指を検査面に押し当てると、指が線材に確実に接触するため、仮に指からの放電が発生しても、静電気は線材を通じて逃げる。このため、放電によって静電容量検出用セルが破壊されることが抑制される。

【0018】

【発明の実施の形態】以下、本発明の実施の形態について図面を参照して説明する。

第1実施形態

図1は本発明の静電容量式指紋センサの一実施形態の構

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造を示す断面図であり、図2は静電容量検出用セルの構造を示す断面図であり、図3は半導体チップの検出面側の構造を示す平面図である。図1～図3に示すように、本実施形態に係る静電容量式指紋センサ1は、半導体チップ2と、ダイパッド41と、パッケージ部材31と、ワイヤ11と、接地電極45とを有する。

【0019】半導体チップ2は、図3に示すように、指紋を検出するための複数の静電容量検出用セル3がマトリクス状に形成されている。半導体チップ2は、たとえば、数 cm^2 程度の面積を有しており、静電容量検出用セル2は、この面積内に、たとえば、数万～数十万個のオーダで形成されており、たとえば、数 μm ～数十 μm の間隔で配置されている。図3に示すように、静電容量検出用セル3は、絶縁層20上に形成された導電性材料からなる電極21を有しており、これら電極21は誘電体からなる保護膜22で被覆されている。なお、保護膜22の最表面が上記の検出面2aとなっている。静電容量検出用セル3の電極21は、たとえば、アルミニウム等の金属材料から形成されており、一辺の長さが、たとえば、数十 μm に形成されている。保護膜22は、たとえば、SiNやSiO₂を基材とする厚さ数 μm の膜である。

【0020】静電容量検出用セル3の形成方法は、たとえば、シリコン基板等の半導体基板上に少なくとも絶縁層を介して、たとえば、CVD (Chemical Vapour Deposition) 法を用いて金属材料からなる導電層を形成し、通常のフォトリソグラフィ技術を用いてパターンニングして電極21を形成し、電極21を被覆するように、保護膜22を所定の膜厚で堆積させる。

【0021】ダイパッド41は、半導体チップ2を、たとえば、接着材を介して保持している。ダイパッド41は、たとえば、銅、アルミニウム等の導電性を有する金属材料からなる板材である。

【0022】パッケージ部材31は、半導体チップ2とダイパッド41を被覆するように形成されており、かつ半導体チップ2とダイパッド41とを固定している。また、パッケージ部材31は、たとえば、通常の半導体装置のパッケージに用いられる樹脂材料から形成されている。また、パッケージ部材31は、半導体チップ2の検出面2aが露出するように、開口部3aを有している。

【0023】ワイヤ11は、導電性を有する線材であり、たとえば、ステンレスワイヤ等の線材を用いることができるが、本実施形態では、強度上の観点からカーボンファイバを用いる。ワイヤ11は、半導体チップ2の検出面2aに接触した状態で検出面2aを横切って架張されており、たとえば、図3に示すように、ハッチングで示すような同一方向に配列された静電容量検出用セル3を横断するように設けられる。また、たとえば、図4に示すように、同一方向に配列された各静電容量検出用セル3の間を横断するように設けてもよい。ワイヤ11

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の両端部は、図1に示したように、半導体チップ2に対してパッケージ部材31内に一体的に固定されている。

【0024】ワイヤ11の一端部11aは、ダイパッド41の表面に接続され、ワイヤ11とダイパッド41とは電氣的に導通している。

【0025】接地電極45は、パッケージ部材31内に固定され、一部がパッケージ部材31から突出するように設けられている。接地電極45は、たとえば、金線、アルミニウムワイヤ等の導電性部材43によってダイパッド41と電氣的に接続されている。導電性部材43は、パッケージ部材31内に存在する。

【0026】図5は、本実施形態に係る静電容量式指紋センサ1の電氣的構成を示す模式図である。図5に示すように、各静電容量検出用セル3の電極21は、スイッチとして機能するトランジスタ40を介して信号処理回路51に接続されている。マトリクス状に配置された静電容量検出用セル3のうち、同じ行に並ぶ静電容量検出用セル3に接続されたトランジスタ40のゲートは、選択線WLに接続されている。信号処理回路51は、各静電容量検出用セル3の検出した検出信号に基づいて指Fの指紋の像を特定する回路である。

【0027】ここで、静電容量式指紋センサ1の指紋の検出原理について説明する。図6に示すように、各静電容量検出用セル4の電極21は、トランジスタ40を介して列方向の選択線BLに接続され、トランジスタ40のゲートは行方向の選択線WLに接続されている。基準電位を与えた指Fを電極21から距離dの位置に位置させると、電極21と指Fとの間の静電容量Csは、次式(1)によって表される。なお、 ϵ_0 は空気の誘電率であり、 ϵ は電極21上の保護膜22の誘電率であり、Sは電極21の面積である。

$$【0028】Cs = \epsilon \cdot \epsilon_0 \cdot S / d \quad \dots (1)$$

【0029】したがって、静電容量式指紋センサ1の電極21に指Fを対向させない状態では、電極21と指Fとの距離dは無限大となり、電極21上の静電容量Csは0となる。

【0030】図7に示すように、指Fに基準電位Eを与えた状態で、静電容量式指紋センサ1の電極21に近接させると、指Fの有する指紋の凹凸によって、電極21a、21bと指Fとの距離dは、それぞれd1、d2のように異なる。このとき、選択線BLを所定電圧Vccでプリチャージし、選択線WLに電圧を印加してトランジスタ40をオンすると、各電極21a、21bには距離d1、d2によって決定される静電容量Csに応じた電荷が蓄積され、これら電荷量に応じて選択線BLの電位が変化する。選択線BLの電位変化量ΔVは、選択線BLの寄生容量をCbとすると、次式(2)で表される。

$$【0031】\Delta V = \{Cs / (Cb + Cs)\} Vcc \quad \dots (2)$$

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【0032】電位変化量ΔVは、電極21と指Fとの距離dによって決定される静電容量Csに応じた量であり、各静電容量検出用セル2における選択線BLの電位変化量ΔVを上記した信号処理回路51に読みだすことで、指Fの有する指紋の凹凸状態を特定することができる。

【0033】次に、上記構成の静電容量式指紋センサ1の指紋検出動作の一例について説明する。たとえば、静電容量式指紋センサ1に接触させる指Fが帯電しており、指Fに基準電位Eを与える前に指Fから静電容量式指紋センサ1に向けて放電する場合を考える。なお、静電容量式指紋センサ1の接地電極45は接地されているものとする。図8に示すように、指Fを半導体チップ2の検出面2aに接触させると、検出面2a上にはワイヤ11が横断しているの、指Fはワイヤ11に確実に接触する。これによって、指Fには基準電位である接地電位が付与される。指Fを半導体チップ2の検出面2aに近づけた際に、人体が帯電しており指Fから放電すると、放電電流はワイヤ11に流れ、ダイパッド41および導電性部材43を通じて接地された接地電極45に導かれる。このため、放電電流が静電容量検出用セル3に直接流れることがなく、放電によって、たとえば、静電容量検出用セル3の有する保護膜22等が絶縁破壊することが抑制される。以上のように、本実施形態によれば、複数の静電容量検出用セル3が形成された検出面2a上に導電性を有するワイヤ11を設けたことで、静電容量検出用セル3は指Fから放電が生じても破壊されにくくなる。

【0034】ここで、図8に示したように、半導体チップ2の検出面2aに指Fを接触させた状態では、指Fがワイヤ11に接触するため、この接触領域では指Fは変形する。このため、指Fが変形した領域では、指紋を検出することができない不感領域Rが発生する。たとえば、図3に示したように、ワイヤ11を同一方向に配列する静電容量検出用セル3を横断するように設けた場合には、図3においてハッチングで示す一列に並ぶ各静電容量検出用セル3が不感領域R内に位置することになる。また、図4に示したように、ワイヤ11を同一方向に配列する静電容量検出用セル3の間に設けた場合には、図4においてハッチングで示す隣り合う2列の各静電容量検出用セル3が不感領域Rに位置することになる。

【0035】不感領域Rに位置する静電容量検出用セル3は、静電容量式指紋センサ1の組み立て段階においてワイヤ11の配置に応じて予め特定されている。このため、本実施形態では、たとえば、信号処理回路51で不感領域Rに位置する静電容量検出用セル3の検出信号を特定の処理する。具体的には、たとえば、信号処理回路51は、不感領域Rに位置する静電容量検出用セル3の検出信号を指紋の特定に使用しない構成とすることが

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できる。この場合には、指Fを半導体チップ2の検出面2aに対して異なる位置に複数回接触させ、複数回の検出で得られたデータを合成することにより、指紋の全体像を特定することができる。あるいは、不感領域Rに位置する静電容量検出用セル3の検出信号を特別に処理するアルゴリズムを予め用意しておき、このアルゴリズムによって不感領域Rに位置する静電容量検出用セル3の検出信号を補完することで、指紋の全体像を特定することも可能である。

【0036】第2実施形態

図9は、本発明の静電容量式指紋センサの一実施形態の構造を示す断面図である。なお、図9に示す静電容量式指紋センサ201の構成要素のうち、上述した第1の実施形態と同一の構成要素については同一の符号で示している。本実施形態に係る静電容量式指紋センサ201と第1の実施形態に係る静電容量式指紋センサ1との異なる点は、静電容量式指紋センサ201では、ワイヤ11が半導体チップ2の検出面2aと所定の距離 δ で離隔している点である。

【0037】すなわち、静電容量式指紋センサ201では、半導体チップ2上に高さ δ の複数のスペーサ部材46が設けられており、ワイヤ11はスペーサ部材46上に架張され、パッケージ部材31と一体に固定されている。スペーサ部材46は、たとえば、パッケージ部材31と同一の樹脂材料によって形成することができる。

【0038】本実施形態では、このような構成とすることにより、半導体チップ2の検出面2aに指Fを近づけていくと、半導体チップ2の検出面2aよりもワイヤ11のほうが指Fにより近いため、指Fから放電しても放電電流が確実にワイヤ11に導かれ、半導体チップ2に形成された静電容量検出用セルの静電破壊を確実に防ぐことができる。

【0039】

【発明の効果】本発明によれば、静電容量式指紋センサの検出面を横切るように基準電位を与えるワイヤを設け

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たことにより、指からの放電があっても静電容量検出用セルの静電破壊を確実に防止することができ、かつ、指に基準電位を与えることができる。

【図面の簡単な説明】

【図1】本発明に係る静電容量式指紋センサの一実施形態の構成を示す断面図である。

【図2】静電容量検出用セルの構造を示す断面図である。

【図3】半導体チップの検出面側の構造を示す平面図である。

【図4】半導体チップの検出面側の他の構造例を示す平面図である。

【図5】静電容量式指紋センサ1の電氣的構成を示す模式図である。

【図6】静電容量式指紋センサの構造の一例を示す平面図である。

【図7】静電容量式指紋センサの検出原理を説明するための図である。

【図8】静電容量式指紋センサ1の半導体チップ2の検出面2aに指Fを近接させた状態を示す図である。静電容量式指紋センサの構造の一例を示す断面図である。

【図9】本発明に係る静電容量式指紋センサの他の実施形態の構成を示す断面図である。

【図10】静電容量式指紋センサの構造の一例を示す平面図である。

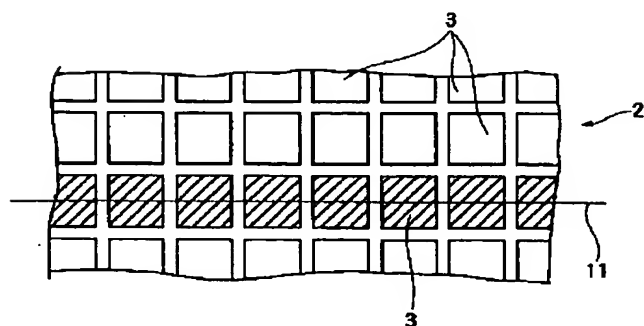
【図11】図10の静電容量式指紋センサの構造の一例を示す断面図である。

【図12】静電容量式指紋センサに指を接触させる際に、指に基準電位を与える様子を示す図である。

【符号の説明】

1…静電容量式指紋センサ、2…半導体チップ、2a…検出面、3…静電容量検出用セル、11…ワイヤ、31…パッケージ部材、43…導電性部材、45…接地電極、21…電極、22…保護膜、41…ダイパッド。

【図3】



【図4】

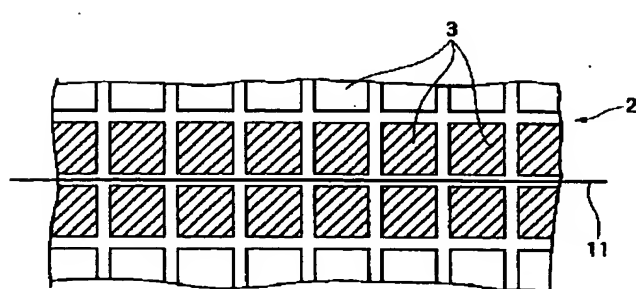
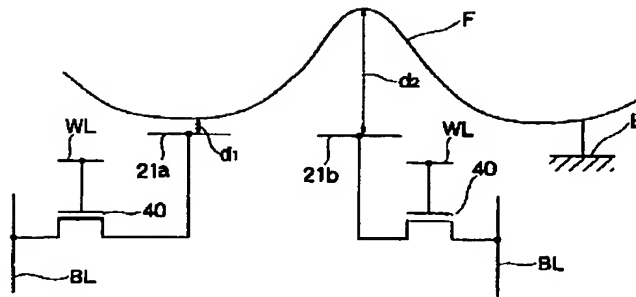


Figure 1 is a perspective view of a semiconductor device 1. The device includes a substrate 11 with a central channel 2. A gate structure 31 is formed on top of the channel, with a gate electrode 31a. A source/drain region 43 is on the left, and a contact pad 45 is on the right. A cross-section line 41 is indicated.

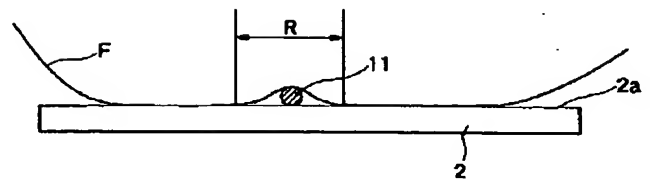
This cross-sectional view shows a substrate 2 with a thin layer 3 on its top surface. The thin layer 3 includes regions 21, 2a, 11, and 22. The substrate 2 is divided into regions 20 and 21.

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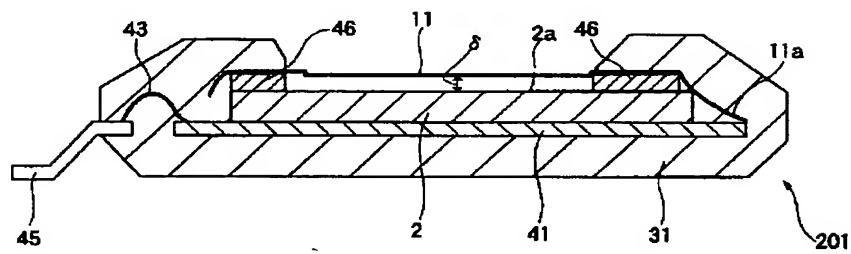
【図7】



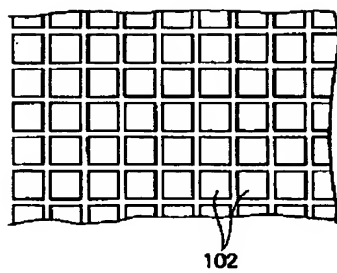
【図8】



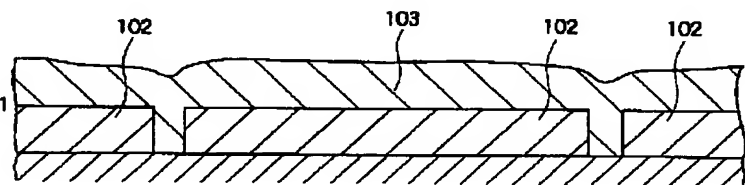
【図9】



【図10】



【図11】



【図12】

